

Lifetimes of Highly-Deformed Rotational States in ^{36}Ar

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Lifetimes have been measured throughout a superdeformed (SD) rotational band recently identified in the $N = Z$ nucleus ^{36}Ar [1]. An 80-MeV ^{20}Ne beam from the ATLAS facility at Argonne National Laboratory was used to populate high-spin states in ^{36}Ar via the $^{24}\text{Mg}(^{20}\text{Ne}, 2\alpha)^{36}\text{Ar}$ reaction. Gamma rays were detected with 101 HPGe detectors of the Gammasphere array, in coincidence with charged particles detected with the Microball array.

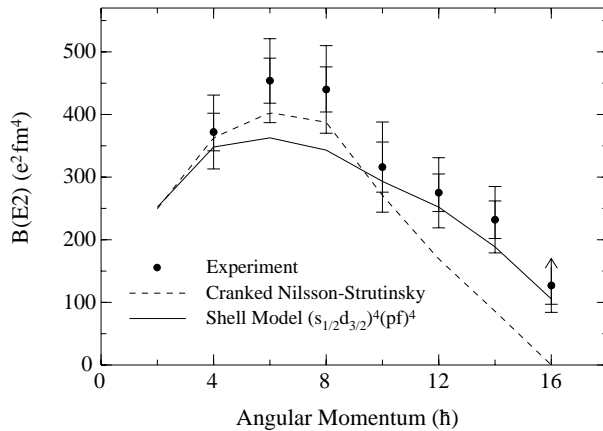


Figure 1: $B(E2)$ values for the SD band in ^{36}Ar compared with the results of cranked Nilsson-Strutinsky and $(s_{1/2}d_{3/2})^4(pf)^4$ spherical shell model calculations.

The $B(E2)$ values deduced from these measurements [2] are shown in Fig. 1. The $B(E2)$ of $372 \pm 59 e^2 \text{ fm}^4$ for the $4^+ \rightarrow 2^+$ transition corresponds to a deformation $\beta_2 = 0.46 \pm 0.03$ for a prolate shape, and we note that the collectivity decreases as the high-spin band termination at $I^\pi = 16^+$ is approached. Figure 1 also shows the $B(E2)$ values predicted by cranked Nilsson-Strutinsky (CNS) and large-scale $(s_{1/2}d_{3/2})^4(pf)^4$ spherical shell model (SM) calculations. The CNS calculations are in good agreement with the low-spin $B(E2)$ values, but underestimate the high-spin collectivity. The SM calculations provide a very good description of the spin-dependence of the $B(E2)$'s, but systematically underestimate their absolute values by 10–20%. This is believed to result from a neglect of the $d_{5/2}$ orbital in the valence space [2].

With essentially complete spectroscopic information, including spins, parities, excitation energies, and $B(E2)$ values, combined with a valence space small enough to be approached from the shell model perspective, the ^{36}Ar superdeformed band provides many exciting opportunities for further studies of the microscopic structure of collective motion in nuclei.

[1] C.E. Svensson et al., Phys. Rev. Lett. **85**, 2693 (2000).

[2] C.E. Svensson et al., submitted to Phys. Rev. C.